USGS
science for a changing world

SEEDS: Strategic Evolution of ESE Data Systems

Life Cycle: Mission Responsibilities

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Premise

- Routine Operations data is not the only data to archive
- Supporting data is also important
  - Engineering design data
  - Pre-launch data
  - OIVP data
  - On-Orbit Calibration data over mission life

Why?

- Supporting data helps put Operational Data in context
  - Satellite/Instrument design
  - Vital for monitoring satellite/instrument performance
- And therefore is *vital* to ensuring the Quality of the Operational Data Archive and *should be maintained*

Engineering and Build Data

- Industry standard practice is to control and keep all designs, drawings, build history, test data
- Engineering data vital to pre-flight and OIVP
- Remains critical throughout mission
  - But less visible and (hopefully) used less often
  - Only to a small group, not majority of users

Engineering & Build Data (cont.)

- Typically maintained by instrument/satellite manufacturer and/or NASA, but…..
  - Given to engineering and launch teams, who go away
  - Private companies sometimes go out of business
  - Some material is poorly described – difficult to understand or use later

Engineering & Build Data (cont.)

- Commercial/Gov't Partnerships add new concerns
  - Designs may be proprietary – who gets access?
  - Lengthy contractual relationships req'd
- International Partnerships
  - Country A built satellite, Country B gets data – who gets support data?
  - ITAR concerns

Pre-Launch and OIV Test Data

- Gathered during Pre-launch and OIV testing
- Often not in standard formats, contents
  - Gathered from incomplete systems, engineering H/W
  - Processed with non-standard software
  - Difficult to archive alongside operational data
- Not valuable without good Content Description
  - Instrument condition, test environment, other special characteristics

Examples and Life Stories

- Landsat 7
  - Heritage Design
  - Engineering data generated in 1970s, 1980s still used today for routine operations
  - Santa Barbara Remote Sensing (SBRS) and Lockheed-Martin (LMMS) under contract for engineering support
  - Pre-launch and OIV data still used in analyses for calibration of recent data

Examples and Life Stories (cont.)

- Landsats 4 & 5
  - Landsat 4 launched 1982, decommissioned in 2001
  - Landsat 5 launched in 1984 – still operating!
  - Instrument aging, engineering documentation has been invaluable in maintaining operations
  - Pre-launch and OIV test data still exists but is poorly documented
    - Afraid to throw it away!

A Case in Point!

Landsat 5 Gets New Lease on Life With Camera Fix

JASON BATES, WASHINGTON

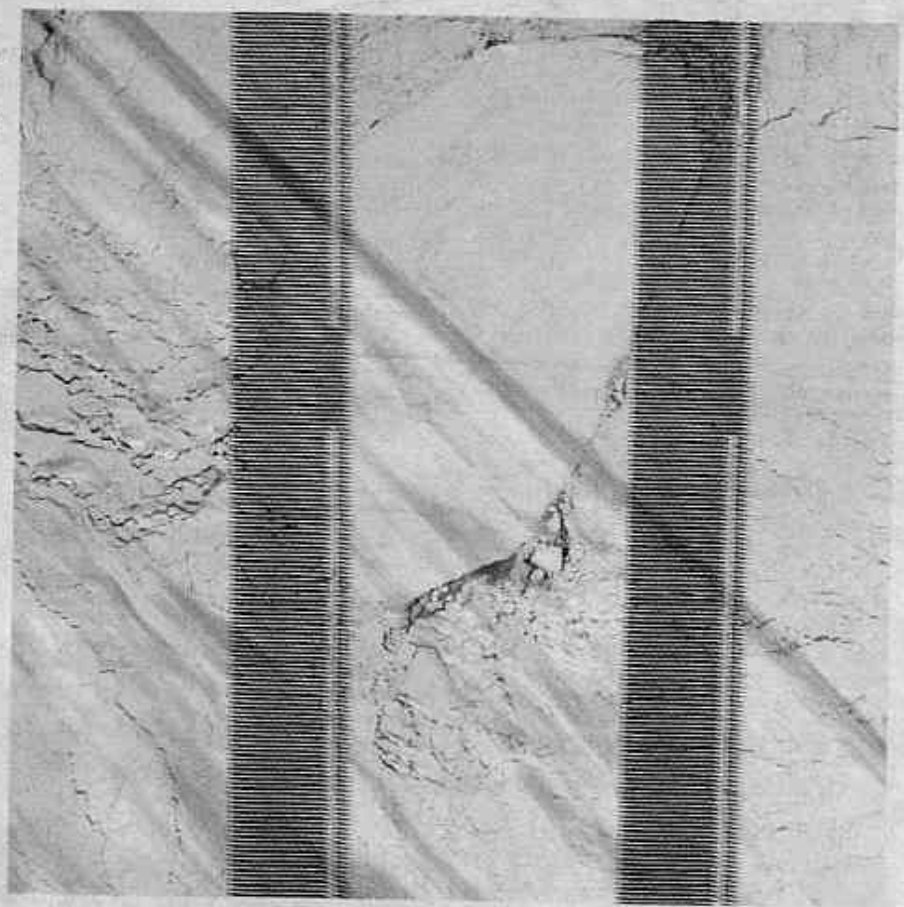
The U.S. Geological Survey (USGS) may get up to three more years of use out of the aged Landsat 5 imaging satellite after correcting a problem with the spacecraft's main camera, agency officials said.

USGS has requested funding in 2003 for continued Landsat 5 operations, and, barring other problems, the spacecraft could last through to its 20th anniversary of on-orbit operations, one official said. Landsat 5, launched in March 1984, was designed to operate for three years.

Eventually, the spacecraft will run low on fuel and will have to be de-orbited.

"We realize as hard as we try, we won't keep Landsat 5 going forever, but we would like to sustain it for as long as it is working effectively," said R.J. Thompson, the Landsat program manager at USGS's Earth Resource Observation Systems Data Center in Sioux Falls, S.D. The satellite has reached the point where several of its critical components are operating without backups, "but so far we have been able to figure out ways to patch it together and keep collecting some very good data," he said.

The most recent problem was a known limitation in the design of the satellite's main camera, called the thematic mapper, said Jim Storey, a USGS engineer based at NASA's Goddard Space Flight Center, Greenbelt, Md. The camera collects imagery with a scan mirror that moves back and forth along a line that runs perpendicular to the satellite's orbital track. The movement of the mirror



USGS SATELLITE IMAGE

Photo Fix: U.S. Geological Survey scientists switched Landsat 5's main camera's calibration shutter to backup mode, solving the problem (above) where lines, dubbed caterpillar tracks because they resem-

erage provided by two spacecraft. Operating in tandem, Landsat 5 and Landsat 7 provide an imaging pass over a given ground location every eight days on average, whereas a single spacecraft can provide repeat coverage every 16 days.

Among the biggest Landsat imagery users is the U.S. Department of Agriculture's Foreign Agricultural Service, which uses the data to monitor crop conditions around the world.

"During the growing season, we need as many passes as we can get during a relatively short period of time," said Alan Vandergriff, director of production estimates in the Foreign Agricultural Service's Crop Assessment Division. "We have operated with 16-day revisit time, but working with eight is a definite advantage."

This is the second time in recent years that Landsat 5 has received a new lease on life. In February 2001, Space Imaging of Thornton Colo., which had been operating the satellite at no cost to the government, told USGS it could no longer afford to do so. The company said it could not sell enough Landsat 5 imagery to compete with data from Landsat 7, which is operated by USGS.

Landsat 5 was scheduled for decommissioning at the end of June 2001, but USGS worked with user agencies to find enough money to keep Landsat 5 operating through the 2001 budget year. Money to cover operations was then included in the U.S. Department of the Interior's 2002 budget.

The Department of the Interior, which

Recommended Best Practices

- Engage Operations & Archive in the earliest stages of instrument/satellite design and build
  - Helps to keep Operations/Archiving in mind of builders
  - Note: Science is often involved in design/build but not Ops/Archive is not!
- One complete set of Engineering Drawings and As-Built records to be archived for life of mission
  - Formatting, access concerns
  - Future computing likely to make task easier

Recommended Best Practices (cont.)

- Test Data:
  - Pertinent test data shall be fully described and archived
    - "Pertinent" defined as potentially useful for understanding instrument/satellite performance or anomalies
    - "Fully Described" includes describing inst/sat configuration, test environment, data formatting
    - Engineering to assist in establishing these criteria
  - Special tools/techniques req'd to analyze data these must be described also

Recommended Best Practices (cont.)

- Pre-Launch Cal/Val data to be archived
  - Must be fully described and annotated
  - "Primitive" data may be kept with engineering data
  - Relatively few users
- Operational Cal/Val data to be archived
  - Metadata describing conditions and nature of cal/val data, analyses, applications also archived
  - Somewhat larger number of users